UTAH GOVERNOR'S OFFICE OF
ENERGY DEVELOPMENT

Plastics - Where Do They Come From?

Grade/Subject: 8th-grade Integrated Science

Strand/Standard 8.1.4 Obtain and evaluate information to describe how synthetic materials come from natural resources, what their functions are, and how society uses these new materials. Examples of synthetic materials could include medicine, foods, building materials, plastics, or alternative fuels. (PS1.A, PS1.B, ESS3.A)

Lesson Performance Expectations (description):

- Students will research different types of plastics and their uses.
- Students will conduct several tests on the plastics to determine their physical properties.

Materials:

- Plastic containers/items from all seven types of plastic. These will be cut into small pieces (students may be assigned to bring and help to collect)
- Internet and device
- These items will be available for the students to choose from for their plastic tests.
  - Paper clips or nails
  - Acetone (fingernail polish remover will work)
  - Denatured alcohol
  - Hot water
  - 250 mL beakers
  - 50 mL beakers
  - Tweezers
  - Paper towels
  - Goggles for each group member
  - Hot plate to heat the water
  - Hot pads to move the hot water

Time: Two periods of 45 minutes

Teacher Background Information:

- Plastics is the term commonly used to describe a wide range of synthetic or semi-synthetic materials. Plastics are organic materials, just like wood, paper or wool. The raw materials used to produce plastics are natural products such as cellulose, coal, natural gas, salt and crude oil. Plastics have a variety of uses, including transportation, containers, medical supplies, packaging and even musical instruments. Some types of plastics can be recycled into clothing, trays, pallets, benches, draining systems, car bumpers, bags etc (EIA).
- Plastics require hydrogen and carbon, which are freely available in the Earth's atmosphere. The most convenient way of accessing them is by extracting them from oil to provide the hydrocarbons ethylene, propylene styrene and more. Hydrocarbons can also be made from methane, coal and biomass (e.g. bio-ethanol) (BPF).

- Other possible raw materials for plastics are: starch, cellulose, sugars, lactic acid, organic waste, vegetable oils, micro-organisms and even the atmosphere itself.
- Fossil fuels represent 99% of the raw material base of plastics.
- Crude oil, a complex mixture of thousands of compounds, must be processed before it is used. The production of plastics begins with the distillation of crude oil in an oil refinery. This separates the heavy crude oil into groups of lighter components. One of these is naphtha which is a crucial compound for the production of plastics.
- Utah has long been a major producer of oil. It is the 11th largest producer of oil in the United States. The first oil production in Utah occurred in September 1948 at the Ashley Valley #1 well operated by Equity Oil Co. in Uintah County, followed in 1955 with the discovery of the Bluebell field in Duchesne County, followed quickly by discovery of the Greater Aneth Field in 1956. As of 2011, Utah was estimated to have the 8th largest proven reserves among states (Trust Lands Administration).
- Utah has five refineries, with over 150,000 barrels per day of refining capacity for gasoline, diesel, jet fuel and related products. While Utah is an overall net exporter of energy, it imports approximately 72% of the crude oil processed here. In 2011, crude oil made up approximately 14% of Utah's total produced energy resources. Crude oil also accounts for 32% of the energy consumed by Utahns (Trust Lands Administration).

Student Background Knowledge:

- Students will need to understand the definition of synthetic materials and natural resources. Natural materials are those that are found in nature and have not been made by humans. By comparison, synthetic materials are man-made and cannot be found in nature. Synthetic products are usually created in laboratories by mixing different chemicals, or prepared compounds and substances made in a laboratory.

Teacher Step by Step: A 3-D lesson should help students think deeply. Provide time and space for the students to experience the phenomenon and ask questions.

1. **Introduce *Phenomenon:*** Show the students the first minute of Indestructible Coating - Polyurea, you can show the rest of it at the end of the class period on the second day. (7 min)
2. Students are to ask questions about the phenomenon and record them on their student sheet.
3. Review with the students where plastics come from.
4. Students will individually research the name and applications of each type of plastic.
5. Divide the students into groups of 2-4 students.
6. Each group will create seven tests that can be conducted on each type of plastic using the equipment and material provided. Make sure that every student is wearing their goggles.
7. Record the results of each test.
8. Students will complete the paragraph after the testing.
9. Each group will be assigned a type of plastic and give a 3-minute presentation to the class. The questions they should address are: What is the name of the plastic? What are its physical properties that were tested? Why is this plastic a good one to use for the applications that were found?
10. Show the remainder of the phenomenon video.

Assessment of Student Learning. Each group will present information on their assigned plastic.

Standardized Test Preparation:

1. Most plastics are produced from which natural resource?
   a. Oil or petroleum*
   b. Mining processes
   c. Plant material
   d. Ocean water

2. Which of the following are characteristics of plastics that make them valuable to people? Choose two.
   a. Breakdown quickly after use
   b. Are flexible and waterproof*

c. Can be created in a home
d. Can be molded into shapes*
e. Are made from renewable resources

Use this information to answer the next two questions.

plastic	Floats in water	Leaves a crease when folded	Changes shape in hot water	Reaction to acetone
A	yes	yes	yes	dissolves
B	yes	no	no	none
C	no	no	no	none
D	yes	yes	no	none
unknown	yes	no	no	none

3. Which plastic would change in an automatic dishwasher set on “hot”?
    a. A*
    b. B
    c. C
    d. D

4. Which plastic is the “unknown” most likely to be?
    a. A
    b. B*
    c. C
    d. D

Extension of lesson and Career Connections:

- Research what raw materials make certain plastics and the process.
- Research the importance of plastics and recycling them in our society today.
- Highlight businesses that use recycled products for their materials
- Develop a plan to minimize plastic waste. This could include recycling/upcycling plastic products.
- Careers in chemical and plastic engineering offer opportunities to design new plastics and new products from recycled plastics.